AMERICAN SOCIETY OF CIVIL ENGINEERS.

INSTITUTED 1852.

TRANSACTIONS.

INTERNATIONAL ENGINEERING CONGRESS,

1904.

THE CONCURRENT DEVELOPMENT
OF TRAFFIC ON IMPROVED WATERWAYS
AND ON RAILROADS.

Congress Paper No. 30.

BY EDWARD P. NORTH, M. AM. SOC. C. E.,
New York City, U. S. A.

Discussion of the Subject by

LEO SYMPHER, Berlin, Germany.

LIONEL B. WELLS, Manchester, England.

TH. HOECH, Kolberg, Germany.

EDWARD P. NORTH, New York City, U. S. A.

NOTE.—Figures and Tables in the text are numbered consecutively through the papers and discussions on each subject.

385
N811c

149e27
LaRue

TRANSACTIONS
AMERICAN SOCIETY OF CIVIL ENGINEERS.

INTERNATIONAL ENGINEERING CONGRESS,
1904.

Paper No. 30.

THE CONCURRENT DEVELOPMENT
OF TRAFFIC ON IMPROVED WATERWAYS
AND ON RAILROADS.

BY EDWARD P. NORTH, M. AM. SOC. C. E., New York City, U. S. A.

Although there is a general, if not exact, knowledge that the average yield of wheat per acre in the United States (13 bushels) is only about 43% of the yield in the United Kingdom, decidedly less than half the yield of Holland and Belgium, 61% of the German yield, and 71% of that of France, the assertion is so constantly made that the phenomenal prosperity of this country is due to its superior fertility and unequaled natural advantages, that there is a nearly universal acceptance of this untrustworthy statement as to fertility. The habit of accepting authorities rather than referring to facts has led public opinion nearly as far astray, if we take the output of coal and iron as a standard for productive wealth, as is usual.

We find on comparing the United States with the United Kingdom of Great Britain and Ireland, that, although we surpassed Great Britain in our make of pig iron in 1890, and mined more coal in 1899, having since made more pig iron than both England and Germany, and nearly equaled the product of the world in 1880,

our output of iron per capita in 1900 was but 83% of the British, and we mined only 58% as much coal.

The production of coal and iron in the United States, and in four European countries, both for equal areas and per capita in 1900, is set forth in Table 1, in which the area and population of Alaska and our non-contiguous islands have been omitted, and the area, production and population of Luxemburg, are added to those of Germany:

TABLE 1.
PRODUCTION OF COAL AND PIG IRON.

	Coal Mined.		Pig Iron Produced.	
	Tons per square mile.	Tons per capita.	Tons per square mile.	Pounds per capita.
United States.....	79.56	3.17	4.55	406
United Kingdom.....	1 865.98	5.49	74.25	489
Germany.....	714.	2.65	40.61	332
France.....	161.24	.86	13.10	155
Belgium.....	2 073.24	3.48	89.73	333

Here it is seen that our natural advantages are not sufficiently greater than those of our neighbors to explain our superior prosperity. The possession of a large area of from cheap to free land has undoubtedly been an important factor in our increased population, and in our aggregate wealth, but the influence of this advantage has been greatly diminished since some time before our development gained such impetus, and our 14% of foreign-born population, arriving as it has lately almost entirely without capital, must have decreased our wealth per capita. Our population and wealth, as ascertained by our Census Bureau, have increased as follows for the years mentioned:

	Population.	Aggregate Wealth.	Wealth per capita
1870.....	38 559 371	\$30 068 518 000	\$779.83
1880.....	50 155 783	42 642 000 000	850.20
1890.....	62 222 250	65 037 091 000	1 038.57
1900.....	76 303 387	94 300 000 000	1 235.86

The aggregate wealth has increased in a partially satisfactory ratio, but during the past 30 years the wealth of individuals in this country has been augmented by less than 60 per cent.

In one great source of national wealth, however, *viz.*: Cost of transportation, which is not a natural product, the United States has an undisputed advantage over all other countries. Shortly before his death, Mulhall said that the average rate received by railroads of different countries for transporting a ton of freight one mile was, reduced to cents: United Kingdom, 2.80; Italy, 2.50; Russia, 2.40; France, 2.20; Germany, 1.64; Belgium, 1.60; Holland, 1.56; United States, 0.8. Acceptance of this statistician's figures as approximately correct, will immediately show that our low cost of internal transportation has probably been the principal cause of our augmented wealth; an augmentation that was greater in the decade ending with 1900 than during the 80 years preceding 1870. For not only does a low freight rate allow more to be divided between producer and consumer, but it has a more potent effect in inviting the production of commodities which with higher freight charges could not reach consumers; thus adding greatly to the employment offered to labor and capital.

Data showing the beneficent effect of low freight rates on production have not been compiled, and any estimate is as liable to be governed by enthusiasm as by knowledge. But reliance is placed on "Poor's Manual," the United States Census returns, and those of the Bureau of Statistics, in submitting Table 2 as showing the direct contributions made by our railroads to the wealth of the Nation.

The highest freight rate during this period was, in 1885, 1.057 cents, and the lowest, 1899, 0.726; since which time the rate has increased by about 5% to 0.764.

If our rates had remained as in 1885 we would have paid \$3 500 000 000 more for transporting our freight than we did, and if our freight rates had been equal to those of England, as stated by Mulhall, and with as large a volume of business possible at such rates, the cost would have been nearly \$33 000 000 000 greater, or more than our increase in wealth during the last decade. There is no doubt that our railroad freight rates are the lowest in the world, and this is probably true also of our coastwise freight rates. Nor

is there reason to doubt that the low cost of assembling and distributing our commodities has had an important influence on their production and consumption.

TABLE 2.
RAILROADS OF THE UNITED STATES.

Years.	Average tons of freight shipped per annum.	Average ton-miles per annum.	Average freight earnings per annum.	Average haul. Miles.	Average freight earnings per ton-mile in cents.	Average ton-mileage per capita.	Average annual payment for freight per capita.
1885-89.....	536.	60,523	602.4	118	0.995	1,031	\$10.26
1890-94.....	717.4	83,524 6	764.	116	0.915	1,283	11.73
1895-99.....	841.6	104,371	817.2	124	0.783	1,457	11.41
1900-02.....	1 116.	148,915	1 125.	133	0.755	1 918	14.49

NOTE.—Figures in 2d, 3d and 4th columns should be multiplied by 1 000 000.

It is noticeable that we have reached this distinctive position as transporters with the highest wages paid for labor known, and until lately with a higher cost for materials than our neighbors and competitors. But both the high wages and high prices have, by stimulating production and consumption, added to the volume of freight moved and reduced its cost.

One influence making for our general prosperity, which should not be lost sight of, is the universal desire for useful development, which, at least avowedly, has governed our financial projects. In 1840, the French economist, Michel Chevalier, wrote after a visit to this country:

“There are certainly wild speculators, blind and desperate gamblers here also; but the objects of their schemes are almost always objects of utility. The spirit of speculation has strewn this country with useful works—canals, railroads, turnpikes, with manufacturing, farms, villages and towns; amongst us it has been more rash, wild and foolish and much less productive in useful results. It is with us mere stock-jobbing.”

A like view was held as late as May 26th, 1899, by *The Engineer*, which said:

"Another phase of the national character has not received half the attention it deserves. Such a man as Hooley is impossible in the United States. * * * The drift of speculation is different. Company mongering as it is practiced here has no existence in the United States. There is plenty of dishonesty and wrong doing, but it is wholly different in kind, and on the whole very much less harmful. Nay, indeed, it is very often indirectly beneficial. Thus, for example, the formation of a copper trust leads to the development of new sources of supply, and the ultimate cheapening of the metal."

While it is possible the last quoted view would not be written to-day, the effect on our freight rates of over 100 years of steady devotion to developing our transportation and production should not be overlooked. And it is possible we are better able to endure some stock-jobbing of the Hooley kind than other peoples.

Accompanying our general honesty of purpose we have had until lately freedom from those laws based on the theory of vested interests which are used both to prevent improvements and solidify monopolies, while our development has been aided by subsidies of various kinds from both State Governments and the General Government, to which local aid has often been added.

Since our organization as a nation we have been pre-eminent for the energy and persistence with which we have developed and improved such aid to our wealth as is offered by water transportation. Improvement of the Mohawk west of Schenectady, the precursor of the Erie Canal, commenced with the adoption of our constitution, and concurrently the navigation of many streams falling into the Atlantic was improved and extended. Our canal-building era was virtually inaugurated by the building of the Erie Canal connecting the navigable waters of the Hudson River with all of our Great Lakes under legislation by the State of New York in 1816. The great influence of this canal after its completion in 1825, with its branches, on land values, and its success as a channel for transportation, led not only to more or less successful efforts to connect the James, the Potomac, the Delaware and the lakes above Niagara with the affluents of the Mississippi, and to many less important projects, but also to such an enlargement of the Erie Canal, authorized in 1835, that the burden of boats could be increased from 40 to 240 tons.

The improvement of rivers, mentioned above, was generally

made by companies operating under State Charters. The canals were generally built directly by the States in which they were situated, but were sometimes aided by National land grants or appropriations of money. Tolls were charged on both rivers and canals, and are still charged on some State Canals. The canals of the State of New York were not made toll free until 1883. Nearly all of these canals assisted materially in the development of the country through which they passed, but as few of them were navigable by boats of over 50 tons burden their value to the public quickly fell after the trains on competing railroads could carry more than the boats. But in their time they added largely to those margins over the cost of living which formed the capital necessary for building the railroads that superseded them.

The net area of lands granted by Congress to States, Territories and Corporations has been: In aid of railroads, 162 000 000 acres; in aid of canals, 4 433 000 acres; in aid of wagon roads, 2 554 700 acres; 168 987 700 acres in all.

On the 6th of April, 1802, the United States entered on its policy of River and Harbor Improvements with an appropriation of \$30 000 for the improvement of the Delaware River. Up to March 3d, 1903, the sums appropriated on this account have reached the aggregate of \$451 344 907.20. During the 58 years ending with 1860 but a little more than \$16 500 000, or less than 4% of this sum, had been appropriated. Taking the appropriations for these improvements by decades we have:

1861-70.....	\$17 290 445.80
1871-80.....	60 440 417.96
1881-90.....	111 687 724.36
1891-1900.....	175 372 564.22
1901-March 3d, 1903.....	70 067 231.24

Approximately 55% of this sum has been expended on the improvement of rivers, 35% on harbors and 10% on canals. Mr. Alfred Noble, in his address as President of the American Society of Civil Engineers, June 9th, 1903, puts the total expenditure by Government for all harbors and waterways on the Lakes above Niagara, as \$68 000 000. Of this sum probably about \$40 000 000 has gone to Lake harbors.

Excepting a few instances, and then but for a short time, the rivers, harbors and canals improved and built by our Government have been absolutely free from charges for their use. While a large proportion of the money expended for improvements has gone to important centers, and the main lines of distribution, minor streams and small harbors, have not been neglected, as advised by many who vainly endeavored to direct public opinion. On the contrary, they have secured about their full share of consideration and the country has not been robbed by the city, to the loss of both.

Although two short roads had been built or commenced before this, our trunk line railroad building was inaugurated consequent on "a meeting of a number of citizens to take into consideration the best means of restoring to the City of Baltimore, that portion of the Western Trade, which has lately been diverted from it by the introduction of Steam Navigation, and by other causes," held in the City of Baltimore, February 12th, 1827. This meeting resulted in a charter for building a railroad from Baltimore to the Ohio River. At substantially the same time, May, 1828, Congress appropriated \$1 000 000 in aid of the Chesapeake and Ohio Canal, which was also to connect the waters of Chesapeake Bay with the Ohio. The Hudson and Mohawk Railroad, which has developed into the New York Central and Hudson River Railroad, was built to abridge the delay to canal traffic caused by the 22 locks between the Hudson River and the Schenectady level of the Erie Canal. The Boston and Albany was built to divert trade at the Eastern terminus of the Erie Canal from New York to Boston. The South Carolina road was projected to connect the harbor of Charleston with the Ohio at Cincinnati.

The first roads were built under special charters, which were generally obtained without difficulty, except in such cases as the Pennsylvanian's objection to the Baltimore and Ohio reaching Pittsburg, on the no doubt honest plea that there could not be traffic enough for two roads. The menace to invested capital, now so strenuously insisted on, is a doctrine hardly 25 years old with us. Afterwards the more enlightened States passed general railroad laws, under which any persons filing the requisite papers became a body corporate, and could make the necessary surveys, and build as much road as they could finance. It is believed that only one

State, New York, ever penalized a railroad. The Utica and Schenectady, now a part of the New York Central and Hudson River Railroad, was for a time prohibited from carrying freight, whether the canal was closed by ice or not, and the railroads which formed that system paid canal tolls to the State on all freight carried until 1851.

The Government of the United States gave a great impetus to railroad building by its legislation of September 20th, 1850, giving to a trunk line railroad between Lake Michigan and the Gulf of Mexico, substantially, six square miles of land for each linear mile built. This aid was so continued that every State and Territory west of the Mississippi and five States east of it, *viz.*, Alabama, Illinois, Mississippi, Michigan and Wisconsin, are indebted to land grants, in a greater or less degree, for their transportation facilities. In aid of the Texas Pacific the land grant was 40 square miles, through the Territories, per mile of road. The Union and Central Pacific Railroads, with some of their branches, in addition to a land grant of 20 square miles per mile of road, amounting to nearly 32 000 000 acres, secured a loan of Government 6% 30-year bonds, varying with the difficulty of construction from \$16 000 and \$32 000 to \$48 000 per mile. This loan was in the aggregate \$62 652 952, of which the Union Pacific received \$27 236 172 and the Central Pacific received \$25 885 120. These loans were repaid with outstanding interest in or about 1898, excepting a small default on the part of one of the branch roads. This combined aid was sufficient to induce the Union Pacific to build 535 miles in one year and 20 days.

The accompanying diagrams, Figs. 1 and 2, made by F. W. Hewes, Esq., for Scribner's, "The American Railway," show the development of our railroads in 1850 with the influence of land grants in 1860 and 1870, the year after the first Pacific Railroad was completed. The direct and indirect influence of land and credit subsidies can be plainly seen by comparing these diagrams with a railroad map of to-day. They have probably hurried the settlement of the West by fully 20 years. But the fact that the Homestead law was passed in 1862 should not be overlooked in this connection.

The British Government, according to the report of a "Com-

mittee on Contract Packets" made in 1853, subsidized its main lines of steamers "to afford a rapid, frequent and punctual communication with those distant ports which feed the main arteries of British commerce, etc."; refusing aid to, if not oppressing, internal communication. On the other hand, the Government of the United States, and also individual States, counties and localities, subsidized its turnpikes, watercourses and railroads almost entirely for the improvement of internal communications, and neglected or oppressed our efforts to reach distant ports. England is pre-eminent as a ship building and ship sailing country, but its people pay the highest internal freight rates known. America now has a contemptible merchant marine, but its internal freight is handled at a rate unapproached in other countries. If, as has been lately urged, our Government was unable to develop at one time both foreign and internal communications, it has apparently adopted the most profitable alternative, though our annual payments to foreigners for over-sea freights are said to exceed the receipts from either Custom dues or the Internal Revenue tax.

While the land subsidies granted by our Government in aid of turnpikes, canals, colleges, etc., have not generally hurried the lands granted into cultivation, it is noticeable that in the case of land granted to railroads the recipients have had a financial interest, strong enough to be a governing interest, in its quick distribution in small holdings, as the possible ultimate value of the land is secondary to the development of traffic on the road. And the Immigration Bureau is greatly aided in its efforts by low freight rates. As the cost of transportation is vital in the eyes of the prospective buyer, its cost has been kept down on non-competitive branches. The beneficent results following the practices of the land-grant aided railroads have not, however, prevented the "friends of the plain people" exhibiting fierce opposition to the development of our unsettled areas through the aid of land grants or other forms of subsidies.

Under the combined influences of local, State and National encouragement with the competition from watercourses which were being increased in capacity, the mileage of our railroads has increased as given in Table 3, to which is added the population per mile, and the total of our foreign commerce in merchandise for the years mentioned:

RAILROADS IN THE UNITED STATES, 1850-1860.

Fig. 1.

TABLE 3.

	Total mileage.	Built per decade.	Inhabitants per mile of railroad.	Foreign commerce, excluding gold and silver.
1830.....	23	.....	560 000	\$134 391 691
1840.....	2 818	2 795	6 057	221 927 638
1850.....	9 021	6 203	2 571	317 885 252
1860.....	30 626	21 605	1 027	687 192 176
1870.....	52 922	22 296	729	828 730 176
1880.....	93 262	40 340	538	1 503 593 404
1890.....	166 664	73 392	375.7	1 647 139 093
1892.....	175 170	.....	371.0	.....
1900.....	194 334	27 680	389.5	2 244 424 266
1903.....	203 132	8 798	389.0	2 445 860 916

The number of inhabitants per mile of road is interpolated for 1892, when it was at the minimum; since that date the number has increased by almost 5 per cent. In the six years including 1893 and '98, only 11 640 miles were built or about 26.5% of the average yearly building in the preceding decade. This decreased building was partly due to a well known loss of commercial confidence during the years mentioned, and possibly to a rumored understanding between financiers interested in railroads, that no more competing lines should be encouraged. This understanding was arrived at before 1890, and the fact that in the six years above mentioned 46 546 miles of railroad were sold under foreclosure proceedings, will probably for some time aid in curtailing the extension of railroads in this country.

The free development of railroad building and the fall in freight rates have also been impeded by the action of State Railroad Commissions. The first of these, for the State of Maine, was appointed in 1853. There are now 34 of them. At first their action was doubtless beneficent, but in some States the appointment of commissioners seems a perquisite of the railroads, and, as notably in the State of New York, it seems virtually impossible for an oppressed community to secure better accommodations or lower rates by investing their own money in a railroad which may reduce the profits of an existing line. All such efforts being apparently held by the commissioners, as well as the stockholders of existing lines, to be a piratical venture and a speculative strike of more or less colossal magnitude.

The value of our Railroad Commissions generally to vested interests, may be partly judged from the subjoined table showing the density of traffic, freight rates, etc., for 1900 in the 8 groups into which "Poor's Manual" divides our railroads.

TABLE 4.

	Maine, N. H., Vt., Mass., R. I., Conn.	N. Y., N. J., Penn., Del., Md., D. C.	Ohio, Mich., Ind., Ill., Wis.	Va., W. Va., N. C., S. C., Ga., Fla.	Ala., Miss., Tenn., Ky., La.	Mo., Ark., Tex., Kan., Colo., N. M., I. Ter., Okla.	Iowa, Minn., Neb., N. D., S. D., Wyo., Mont.	Wash., Ore., Cal., Nev., Idaho, Ariz., Utah.
Groups: No. of States with commis- sions.....	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Area.....	6	1	4	5	5	5	5	3
Population.....	66 465	116 530	249 015	268 205	230 230	768 060	609 315	717 060
Miles of R. R.....	5 592 017	17 106 175	15 985 581	8 791 983	8 929 332	10 462 835	6 106 123	3 020 479
Tons per mile of R. R.....	7 501	23 385	41 138	21 917	16 211	37 530	32 165	15 486
Ton-mile rate.....	6 930	17 951	5 521	2 879	4 167	1 986	2 628	1 791
Population per mile of R. R.....	1.16	0.61	0.69	0.69	0.83	1.00	0.95	0.97
Square miles per mile of R. R.....	745.3	764.2	388.6	401.1	550.8	278.8	289.8	195.0
	8.86	5.21	6.05	12.24	14.20	20.47	18.94	46.30

This table is not submitted as conclusive, but it may be noticed that the railroads of New England, dominated by the most respectable and highly appreciated Commission, exact the most onerous charges on traffic known in this country, and have driven nearly all heavy manufacturing out of their territory.

The Interstate Commerce Commission is directed by the General Government to take cognizance of discriminations and combinations in restraint of transportation as administered for the general good, but it is not empowered to encourage railroad building as a remedy for injustice. In fact, the Government of the United States has no right of eminent domain in any State of the Union, and as it has alienated nearly all its land, cannot encourage railroad building outside of the Territories.*

Note.—The author is indebted to Mr. Brooks Adams for the following correction:

"The United States Government has plenary powers over interstate commerce, and may, therefore, build any roads it likes, provided they are interstate; may charter corporations; may take State roads, and may police them."

A considerable percentage of the 451 million dollars appropriated by the General Government for the improvement of rivers and harbors, has been expended on isolated or semi-isolated projects, where the statistics covering the consequent development of traffic are not available without great research. In other cases like the 18 500 000 net tons of freight traffic found 12 years ago on the Hudson River, or the 11 610 000 tons of freight carried on 11 improved tributaries of the Ohio in 1902, as reported by the Department of Commerce and Labor, no idea of the cost of freightage is given. Nor are the rates charged on the total traffic of the Great Lakes given in the report of the same Department, which gives the average arrivals and departures in domestic trade for the two years 1902-03 for which statistics have been gathered as 74 390 000 and 74 340 000 net tons of freight. During the same two years the average imports of foreign merchandise at these Lake ports have been valued at \$61 187 000 and the exports at \$88 076 000.

As the natural depth at most harbors on the Great Lakes was about 6 ft., and not more than 8 ft. could be carried over the St. Clair Flats, above Detroit, this large traffic would be impossible without the increased depths made by the expenditures authorized by the various River and Harbor bills. The first appropriation, 1823, was for the harbor of Erie. Ohio followed in 1825 with appropriations for Cleveland and Fairport. Buffalo did not get an appropriation from the General Government until 1826; Chicago in 1833, and the St. Clair Flats received its first appropriation, \$20 000, in 1852.

In the last mentioned year, Congress gave the State of Michigan 750 000 acres of public land in aid of a canal connecting Lake Superior with Michigan, Huron and Erie. This canal, built for the State by an incorporated company to which the land was transferred, was opened June 18th, 1855, with two locks of 9 ft. lift, each 350 by 70 by 11½ to 12 ft., to overcome the 18 ft. difference of level at the Falls of St. Mary, or, as it is generally known, the "Soo." The General Government took over this canal from the State of Michigan, June 9th, 1881, and completed the "Weitzel" lock, 515 by 80 by 17 ft., September 1st, 1881, and the "Poe" lock, 800 by 100 by 22 ft., August 3d, 1896. The Canadian Government had in the meantime built a lock 900 by 60 by 22 ft., opened September 9th, 1895.

These figures are from the "Statistical Report on Lake Commerce," 1903. The depths of Lake channels, in general, have been less than the depths on the lock sills. Tolls amounting to \$778 128.41 were collected on the 19 414 242 net registered tons of shipping passing through the canal in the 26 years, including 1880, that the canal remained State property. They were 6 cents per net registered ton until 1871; 4½ cents until 1879, and after that 3 cents. Since 1880 the traffic through both the American and Canadian locks has been free.

We are fortunate in having the net tonnage passing through the canal from its opening, and since 1887 the U. S. Engineers in charge of the canal, with the co-operation of those in charge of the Canadian Canal, have kept and published statistics which are among the most valuable in the history of transportation. From these data Tables 5, 6 and 7 have been compiled.

TABLE 5.—FREIGHT TONS PASSING THE SOO.

YEAR.	Tons.	Total Value.	Value per Ton.
1851.....	12 600	\$1 675 000	\$133.00
1861.....	88 000	6 000 000	68.00
1871.....	585 000	13 000 000	22.00
1881.....	1 568 000	30 000 000	19.00
1891.....	8 889 000	128 000 000	14.50
1901.....	28 408 065	289 916 865	10.20
1903.....	34 674 437	349 405 014	10.08

TABLE 6.—NET REGISTERED TONNAGE PASSING THE LOCKS AT SAULT STE. MARIE (THE SOO).

Year.	Tonnage.	Year.	Tonnage.	Year.	Tonnage.	Year.	Tonnage.	Year.	Tonnage.
1855	106 296	1865	409 062	1875	1 259 534	1885	3 035 937	1895	16 806 781
1856	101 458	1866	458 530	1876	1 541 676	1886	4 219 397	1896	17 249 418
1857	180 820	1867	556 899	1877	1 439 216	1887	4 897 598	1897	17 619 933
1858	219 819	1868	432 563	1878	1 667 136	1888	5 130 659	1898	18 622 754
1859	352 642	1869	524 885	1879	1 677 071	1889	7 221 935	1899	21 958 847
1860	403 657	1870	690 826	1880	1 734 890	1890	8 454 435	1900	22 315 834
1861	276 693	1871	752 101	1881	2 092 757	1891	8 400 685	1901	24 626 976
1862	359 612	1872	914 735	1882	2 468 088	1892	10 647 203	1902	31 955 582
1863	507 434	1873	1 204 446	1883	2 042 259	1893	8 949 754	1903	27 736 444
1864	571 438	1874	1 070 867	1884	2 997 837	1894	13 110 366		

TRAFFIC ON WATERWAYS AND RAILROADS.

TABLE 7.—TRAFFIC THROUGH THE LOCKS AT ST. MARY'S FALLS, OTHERWISE CALLED "THE SNOO."

Year.	Tons carried.	Ton-miles.	Average distance.	Take cost of carriage.	Cost per ton-mile.	Average rail-road freight rates per ton-mile.	Railroad cost for equal ton-miles.	Total value of freight carried.	Value per ton.	Percentage of value paid for transportation.
(1)	(2)	(3)	(4)	(5)	(6) Mills.	(7) Mills.	(8)	(9)	(10)	(11)
1887.....	5 494 649	4 458 544 804	811	\$10 075 153	2.3	10.34	\$46 101 353	\$79 031 757	\$13.83	12.75
1888.....	6 411 423	5 173 132 972	806	7 883 077	1.5	9.77	50 541 509	83 186 019	12.81	9.50
1889.....	7 516 022	5 910 646 352	790	8 634 247	1.5	9.70	57 632 270	83 732 527	11.14	10.31
1890.....	9 041 213	7 207 289 415	797	9 472 215	1.3	9.27	66 811 646	102 214 948	11.30	9.36
1891.....	8 888 759	7 232 462 269	820	9 819 023	1.35	9.29	67 746 974	128 178 208	14.42	7.48
1892.....	11 214 333	9 222 773 948	822	12 072 851	1.31	9.41	56 786 303	135 117 297	12.49	8.48
1893.....	10 706 572	8 080 310 240	821	9 057 483	1.10	8.48	80 194 170	145 486 957	13.47	6.84
1894.....	13 105 890	10 027 871 324	821	10 298 310	0.99	8.64	94 416 808	143 114 562	10.80	7.54
1895.....	15 062 580	12 502 548 802	830	14 238 758	1.14	8.39	104 806 385	159 575 129	10.59	8.92
1896.....	16 229 051	13 582 641 886	836	13 511 616	0.99	8.21	111 513 490	195 146 842	12.02	6.87
1897.....	18 982 755	15 909 393 576	841	13 220 100	0.83	7.97	127 275 067	218 225 927	11.49	6.46
1898.....	21 254 064	17 801 507 030	843	14 125 806	0.79	7.58	135 618 305	223 069 740	10.98	6.10
1899.....	25 255 810	20 801 944 628	827	21 559 707	1.05	7.26	151 675 518	281 364 750	11.14	7.80
1900.....	25 643 073	21 179 229 014	826	24 953 314	1.18	7.5	158 844 218	297 041 959	10.41	9.34
1901.....	25 403 095	23 383 801 978	823	23 217 074	0.90	7.6	177 717 351	299 906 965	10.21	8.01
1902.....	35 861 146	29 735 910 637	827	26 506 169	0.80	7.6	226 144 366	358 306 300	9.69	7.42
1903.....	34 674 457	28 974 060 408	836	26 727 735	0.92	....	....	349 405 014	10.08	7.66
	294 015 422	243 334 835 372	827.6	\$257 203 648	1.057		\$1 743 900 353	\$3 251 034 711	11.06	7.91

Note.—All of the tons mentioned in this paper, excepting those specified as net registered tons, are the usual freight tons of the country, of 2 000 lb.

The values given in Tables 5 and 7 are values on the docks at points of delivery, and the freight rates include loading and unloading. Exact value is not claimed for either the several items, or the total, of Column 8 in Table 7. For water-borne freight is always of a lower average classification than railroad freight. But as during the 16 years, ending with 1902, that the Engineer Officers of our army have kept reliable statistics of the traffic through the "Soo," the difference on an equal classification between the actual and railroad charges is nearly four times the total expenditures for River and Harbor improvements by the Government, it is not necessary to be rigorously exact to show that the expenditures authorized were reproductive expenditures. Mr. Noble, in the paper above quoted, says of the traffic of 1902, which he compares with a charge by rail of only 3 mills per ton-mile: "This amount of saving on Lake Superior commerce alone, during a single year, is within \$5 000 000 of the entire amount appropriated by the United States for all harbors and waterways on the Lakes above Niagara Falls from the formation of the Government; if the commerce between Lake Michigan and Lake Erie be included, the annual saving greatly exceeds the amount thus appropriated."

As only 41½ of the 958½ statute miles between Duluth and Buffalo have required improvement to accommodate vessels of 20-ft. draft, and the same improvement has sufficed for the 885 miles between Chicago and Buffalo, the combined traffic on these routes being without an equal in any other channel, no other improvement undertaken by our Government has had so beneficent an effect on our national wealth, nor, it is possible, has returned so large a dividend on the money expended. But many instances have been mentioned in our local papers where the savings on increased freightage have returned from 30 to 60% for the year on the cost of the improvement.

In consequence of repeated comparisons like that of Mr. Noble, the first of which it is thought appeared in 1890, neither those so educated that they can see no significance in the inverse relation between the value per unit and the volume of Lake freight, nor any advocate of supposed railroad interests, can any longer secure respectful auditors to the phrase, "River and Harbor Steal," which

for many years was applied to Congressional effort to increase the national wealth by decreasing the cost of internal transportation, and the claim by obstructionists that any appreciable percentage of the River and Harbor appropriations is non-productive and wasted, no longer receives consideration.

It is not proposed to refer to the economies, many of them calling for large expenditures, by means of which our railroads have become the chief of the labor saving appliances, not only of this country but of the world. But aside from the influence of our, one time, free railroad building, these economies have in almost all instances been forced on our railroad managers by the competition of improved waterways; which while their traffic fed, and was fed by, the railroads, cut rates to an extent that called out high intellectual effort in the attempt to compete on a paying basis. This competition has resulted in our being able to produce and ship a third more freight per capita, despite our longer haul, than any other people, and has filled our country with consumers, who, as James Bryce says in his "American Commonwealth," "allow themselves luxuries such as the masses enjoy in no other country." And the traffic in luxuries as well as in passengers is generally transported by rail.

There has been one noticeable instance in which the railroads led in improvements to waterways, forcing the deepening of the Lake channels. This was a consequence of the rate wars of the Seventies, which covered much of the United States, but was most intense between the roads connecting Chicago with New York. Under this rivalry the Lake commerce seemed to be dying. The situation at that time is tersely and ably described in the "Report of the Committee on Canals of New York State, 1899," made to then Governor, now President, Roosevelt. It says:

"In 1875 the total tonnage on the lakes was nearly 600 000 tons. * * * The traffic, as estimated by entrances and clearances at American ports, was for that year about 15 000 000 tons.

"This development had, however, been secured without any material increase in the size of the vessels in use—a limit being placed on size by the depth of water in the harbors and in the channels connecting Lake Erie and Lake Superior with Lake Huron-Michigan. By 1875 the advance in railroad construction and manage-

ment had reached a point which enabled the railroads to compete with the lake vessels; and when to this was added the railroad rate wars of the next few years there was not only a cessation of increase in lake commerce, but a positive decline both in equipment and traffic. New construction of vessels, which had reached as high as 73 000 tons in 1874, was only 7 000 tons in 1877, and averaged only 13 000 tons a year for the five years ending in 1880. In the latter year all the vessels on the lakes aggregated only 560 000 tons, 30 000 less than five years before.

"The beginning of the new decade marked a significant revival in lake commerce, which cannot be disconnected from the improvements in lake harbors and channels undertaken by the national government. The most important work brought to completion at this time was the opening of the ship canal with an 18-ft. draft, which took the place of the 10-ft.* canal and locks maintained by the State of Michigan at Sault Ste. Marie, but other works were well under way, which have had for their ultimate aim the securing of 20 ft. of water in all the main channels and important harbors on the lakes."

If the existence of the Lake business as well as the Lake marine, had not been threatened by the development of improved methods of conducting railroad traffic, it may be doubted if Government would have received sufficient support to justify it in entering on the heavy expenditures necessary for navigable channels 18 and eventually 20 ft. in depth. There is always available such testimony as was given in 1870, by one prominent in Lake commerce:

"It had been clearly established that vessels of over 700 or 800 tons were not so profitable on the Lakes as vessels of a smaller size. Nature has placed barriers in front of most of our harbors, also wide flats across some of our greatest thoroughfares, that will, in spite of art, for ages to come, make it necessary to build lighter-draft vessels. Sail vessels of over 800 tons could not safely navigate the lakes even if harbors were deep enough."

Such testimony, by an authority, is always available and influential in procuring delay and insufficient improvements unless there is a strong interest capable of organization to confute it. And as the nearly accomplished improvement has resulted in 19 vessels, carrying over 8 000 net tons each, passing the Soo last year, the testimony seems confuted.

The United States possesses no noticeable superiority in natural resources, and is handicapped by the necessity of finding money

* An evident misprint for 11¼ to 12 ft.

to do in a part of a century that for which other countries have taken nearly a thousand years. It has in the aggregate exhibited a superiority in general honesty of purpose and in the broad-mindedness of its legislators, both national and local. It is largely through legislation, notably and peculiarly in its help to all schemes for increasing wealth by diminishing the cost of interchange between producers and consumers, that this country has attained its superiority. From the fairly equal distribution of subsidies and direct payments between waterways and railroads, there has issued a system of mutually beneficent rivalry, in that the railroads often own boat lines and the boat lines have owned railroads, which has given a higher remuneration to the producer, and a lower cost to the consumer, than would have been possible under any other system.

As a resultant our internal commerce for 1902 is estimated at \$20 000 000 000. These figures are given by our Bureau of Statistics:

"It is estimated that the internal commerce of the United States now annually amounts in value to at least \$20 000 000 000. This estimate is based on one transaction in each of the leading classes of commodities produced in the several different divisions of national industry. On the basis of the figures of the Twelfth Census the products of agriculture are valued at nearly \$4 000 000 000; manufactures, \$13 000 000 000; minerals, \$1 000 000 000. To these the products of the forests, of fisheries, and other minor forms of industry should be added at a valuation of certainly not less than \$3 000 000 000. Including also the growth of commerce since 1900, there can be no doubt as to the aggregate for 1902 being fully \$20 000 000 000."

Our foreign commerce amounts to nearly 12% of this sum, and 6.8% of it suffices to settle our foreign balances, and pay for our foreign transportation with such luxuries and raw materials as we require from other countries.

Exclusive of the benefits derived from land grants, there seems to be no reason why any other country should not develop its transportation systems in a manner analogous to that pursued by the United States and reap as substantial a reward.

TRANSACTIONS
AMERICAN SOCIETY OF CIVIL ENGINEERS.

INTERNATIONAL ENGINEERING CONGRESS,

1904.

DISCUSSION ON
THE CONCURRENT DEVELOPMENT
OF TRAFFIC ON IMPROVED WATERWAYS
AND ON RAILROADS.

BY MESSRS. LEO SYMPHER, LIONEL B. WELLS, TH. HOECH AND
EDWARD P. NORTH.

LEO SYMPHER, Esq., Berlin, Germany.* (By letter.)—As a con- Mr. Sympher.
sequence of the canalization of the Main, the coal tonnage of the
railroad from the Ruhr District to Frankfort dropped from 77 000
to 40 000 tons in 1886. The first year in which the whole canal was
opened to service was 1887. In 1888, the tonnage rose to 41 000
tons, but since that time it has again nearly reached the old figure.
Inasmuch as a large part of the coal tonnage is now sent to Frank-
fort before being reloaded to the railroads, the railroad tonnage for
other parts of South Germany has been affected. No large falling
off in the transportation of coal by rail between the Ruhr District
and South Germany, however, has taken place since the opening of
the canal; on the contrary, if we except 1888 and 1889, there has
been a steady increase. Despite the fact that the railroad coal
tonnage of Frankfort has fallen off, the total freight tonnage of the
railroads has increased from 911 000 to 1 909 000 tons in the 16
years since the opening of the canal. A large proportion of this in-
crease, however, should be credited to those classes of freight that
call for reloading from canal-boat to train or *vice versa*. This does

* Geheimer Baurat.

Mr. Sympher, not necessarily mean an increase of income for the railroads, in fact, for some cases, it indicates a loss. Deducting the freight tonnage due to reloading, we still have an increase from 896 000 tons in 1886 to 1 234 000 tons in 1902. Taking the total freight moved through Frankfort, less the coal and reloaded tonnage, we have an increase from 661 000 tons in 1886 to 974 000 tons in 1902, or 47 per cent.

At no time since the Main Canal was opened for operation has the railroad freight tonnage been less than it was before. It is only when we deduct the reloaded tonnage that we find a loss of 110 000 tons, or about 12% of the total freight tonnage in the second year of operation. On the other hand, we have a great increase in the canal tonnage. This, in 1886, amounted to 156 000 tons, of which 12 000 tons are credited to the Lower Main, which had been opened in the autumn; in 1902 the tonnage amounted to 1 273 000 tons, of which 1 116 000 tons should be credited to the lower part of the Main. In the canalized part of the Main we have, therefore, the same result as has been found in other canals and canalized rivers, *i. e.*, the coal traffic, that is to say, the principal freight, is largely diverted from the railroads to the canals. On the other hand, all other classes of freight show so great an increase that there is no diminution of freight receipts on the railroad.

The railroad freight of the City of Frankfort has increased from 911 000 tons in 1886 to 1 909 000 tons in 1902; the reloaded freight has increased from 15 000 tons in 1886 to 675 000 tons in 1902; and the net actual local freight has increased from 896 000 tons in 1886 to 1 234 000 tons in 1902. Government freight is not included in the above.

The reloaded freight has shown a steady increase from 1886 to 1902. The local freight showed a small loss for two years, *viz.*, from 896 000 tons in 1886 to 786 000 tons in 1887 and 895 000 tons in 1888; since that time there has been a constant increase up to 1 234 000 tons in 1902. The water freight of Frankfort has shown a proportionately larger increase. In 1886 it amounted to 156 000 tons, and in 1902 had risen to 1 273 000 tons. Deduct from this figure the freight on the Upper Main, which was not improved by canalization, and there remains for the Main Canal 12 000 tons for 1886, as against 1 116 000 tons for 1902.

The Harbor of Frankfort has diverted from its rival, the harbor at the junction of the Main and Rhine Rivers, at least 75% of the freight reloaded for Hesse, Bavaria and Austria. Nearly all this loss fell on Gustavsburg, which did not recover until 1893, or, in other words, received a setback in its development for seven years.

The amount of coal received by rail from the Ruhr District at Frankfort was as follows:

1886.....	77 340 tons.	Mr. Sympher.
1887.....	36 640 “	
1888.....	35 800 “	
1901.....	89 810 “	
1902.....	56 970 “	

The amount of reloaded freight in coal was as follows:

1886.....	37 340 tons.
1887.....	71 430 “
1888.....	119 380 “
1901.....	233 980 “
1902.....	243 110 “

The total amount of coal shipped from the Ruhr District to South Germany was as follows:

1886.....	1 027 600 tons.
1887.....	1 081 170 “
1888.....	974 690 “
1889.....	1 006 650 “
1890.....	1 311 280 “
1901.....	1 805 280 “
1902.....	1 578 680 “

The amount of freight passing through the Main at its junction with the Rhine (lock at Kostheim) was as follows:

Year.	Boat freight.	Lumber rafts.	Total.
1877	494 000 tons.	192 000 tons.	686 000 tons.
1888	724 000 “	140 000 “	864 000 “
1889	784 000 “	155 000 “	939 000 “
1890	928 000 “	201 000 “	1 129 000 “
1891	835 000 “	162 000 “	997 000 “
1892	1 011 000 “	194 000 “	1 205 000 “
1893	1 045 000 “	165 000 “	1 210 000 “
1894	1 249 000 “	150 000 “	1 399 000 “
1895	1 071 000 “	180 000 “	1 251 000 “
1896	1 529 000 “	225 000 “	1 754 000 “
1897	1 340 000 “	251 000 “	1 591 000 “
1898	1 634 000 “	270 000 “	1 904 000 “
1899	1 620 000 “	317 000 “	1 937 000 “
1900	2 033 000 “	294 000 “	2 327 000 “
1901	1 860 000 “	273 000 “	2 133 000 “
1902	1 924 000 “	218 000 “	2 142 000 “
1903	2 462 000 “	295 000 “	2 757 000 “

By the statistics of the Chamber of Commerce, it is shown that, while there was a falling off in certain classes of railroad freight,

Mr. Sympher. coal in particular, the railroads show absolutely no loss in total freight tonnage at any time; in fact, a very constant increase can be proven. At the same time, the new waterway has greatly aided the commercial development.

In consequence of the ease of obtaining water and for the disposal of sewage, etc., the banks of the Main River have been used for a long time by various industries, particularly by chemical and dye works. The use of the river for freight transportation was rendered impossible by reason of the rapid fluctuations in the rate of flow, the poor condition of the channel and the difficulty of providing proper landings. In 1886 the canalization of the Main was completed, and the effect of the same on the various industries was very marked. This is proven by a comparison of the freight tonnage of the different classes of manufactures, etc., for 1886 (immediately before the canal was put in service) with those for 1902. The following table shows this in detail:

				Total 1902.	Traffic, in Tons. 1886.
Class 1	Group	Ve	1 Tube Works.....	13 550	...
	"	VIa	1 Machine Works....	1 584	180
Total				15 134	180
"	2	"	IVb 2 Lime Works.....	90 150	16 900
"	5	"	XXa 3 Railroad Traffic....	2 628 400	1 073 000
	"	"	XXb 2 Canal "	1 207 800	23 896
Total				3 836 200	1 096 896
"	6	"	VIIb Chemical Works...	13 000	 (1887)
	"	"	VIIId Dye Works.....	414 100	155 000
	"	"	VIIId 1 Chemical Factories.	303 810	95 962
	"	"	VIIIId Oil Factory.....	9 200	7 215
	"	"	Xa 2 Paper Factory.....	40 221	319
Total				780 331	258 496
"	7	"	XIIa 2 Celluloid Factories.	20 863	1 000
	"	"	XIIIe 5 Breweries	58 586	43 204
Total				79 449	44 204

The chemical industries, Class 6, show a great increase, due no doubt to the reduced freight, both on raw materials (coal in particular), and on a large part of the product. In consequence thereof

many new factories have been built along the Main. Local pro- Mr. Sympher.
ductions have also been favored by the cheaper transportation.

For the solution of the problem as to how much traffic existing railroads lose by reason of the new canals, many cases can be cited where both have shown a favorable development. It is, however, seldom possible to prove this as clearly and undoubtedly as is done by the statistics concerning the Oder-Spree Canals. These are singularly free from all doubtful or hypothetical figures.

As is well known there was formerly a water route between Silesia and Berlin, Brandenburg and Hamburg, by way of the Oder, Frederick William Canal and the Spree. The water freight was unimportant, amounting to about from 200 000 to 300 000 tons in the early Eighties; on the other hand, the railroad freight, from Oppeln to Berlin, Brandenburg and Elbe Harbor amounted to 1 200 000 tons in 1883 and 1 800 000 in 1890.

After the completion of the Oder-Spree Canal in 1891, the canalization of the Upper Oder in the autumn of 1895 and the ship canal at Breslau in 1897, a great change took place in the shipping between Upper Silesia and Berlin, etc. Before these improvements were made transportation was limited to boats of 125 tons capacity, but after they were completed the canal was deep enough for boats up to 400 tons capacity. By this means a modern equipment for water transportation was possible—let us see how it affected the railroads.

It must be explained here that the statistical data available do not permit of comparing strictly identically travelled districts for railroad and water routes. It will be sufficiently accurate to assume that the greater part of the freight passing Furstenburg on the Oder is for Berlin, the Province of Brandenburg or Hamburg, or has come from there, and that the greater part has either come from or is destined for the Oppeln District in Upper Silesia. In the absence of other data, it will be proper to compare the Oder-Spree Canal freight with the railroad freight between Upper Silesia and Berlin, Brandenburg and Hamburg. In so doing we neglect the comparatively unimportant tonnage that arrives by water in the Province of Brandenburg by routes other than the Frederick William and Oder-Spree Canals. Space will not permit of giving all the statistics available, and, in Tables 8, 9 and 10, no figures are given between 1883 (the first year in which official records were kept) and 1890 (the year before the Oder-Spree Canal was opened).

Tables 8, 9 and 10 show that the freight on the Oder-Spree Canal was very light at the start, but it has increased from year to year, so that in the first eleven years it has been more than quadrupled. In the opening year, 1891, the freight amounted to 446 000 tons and in 1902 to 1 819 000 tons.

Mr. Sympher. TABLE 8.—FREIGHTS ON THE FREDERICK WILLIAM AND THE ODER-SPREE CANALS.

YEAR.	FREDERICK WILLIAM CANAL, PASSING BRIESKOW.		ODER-SPREE CANAL, PASSING FURSTENBURG.		SUM TOTAL.	
	Total tons.	Of which hard coal = tons.	Total tons.	Of which hard coal = tons.	Total tons.	Of which hard coal = tons.
1883.....	235 000	37 000	.....	.....	235 000	37 000
1890.....	243 000	105 000	.....	.....	243 000	105 000
1891.....	425 000	247 000	446 000	216 000	871 000	463 000
1892.....	117 000	19 000	856 000	514 000	973 000	533 000
1893.....	130 000	28 000	888 000	533 000	1 018 000	561 000
1894.....	121 000	15 000	1 024 000	614 000	1 145 000	629 000
1895.....	106 000	11 000	941 000	565 000	1 047 000	576 000
1896.....	102 000	7 000	1 154 000	718 000	1 256 000	725 000
1897.....	108 000	15 000	1 369 000	820 000	1 477 000	835 000
1898.....	109 000	12 000	1 468 000	826 000	1 577 000	838 000
1899.....	119 000	19 000	1 679 000	965 000	1 798 000	984 000
1900.....	103 000	14 000	1 610 000	861 000	1 713 000	875 000
1901.....	93 000	11 000	1 633 000	935 000	1 726 000	946 000
1902.....	76 000	9 000	1 819 000	1 088 000	1 895 000	1 097 000

TABLE 9.—RAILROAD FREIGHTS BETWEEN OPPELN, UPPER SILESIA AND:

Year.	BERLIN.		PROVINCE OF BRANDENBURG.		HAMBURG.		SUM TOTALS.		
	Total tons.	Of which hard coal = tons.	Total tons.	Of which hard coal = tons.	Total tons.	Of which hard coal = tons.	Total tons.	Of Which Hard coal tons.	Other freight tons.
1883.....	766 000	699 000	406 000	373 000	14 000	1 000	1 186 000	1 073 000	113 000
1890.....	1 092 000	974 000	735 000	664 000	22 000	9 000	1 849 000	1 647 000	202 000
1891.....	1 037 000	916 000	727 000	638 000	27 000	9 000	1 791 000	1 563 000	228 000
1892.....	961 000	846 000	665 000	579 000	15 000	.....	1 641 000	1 425 000	216 000
1893.....	975 000	856 000	706 000	610 000	16 060	1 000	1 697 000	1 467 000	230 000
1894.....	776 000	676 000	624 000	536 000	15 000	.....	1 415 000	1 212 000	203 000
1895.....	794 000	700 000	605 000	522 000	16 000	.....	1 415 000	1 222 000	193 000
1896.....	745 000	647 000	621 000	531 000	16 000	.....	1 382 000	1 178 000	204 000
1897.....	771 000	671 000	681 000	592 000	18 000	.....	1 470 000	1 263 000	207 000
1898.....	855 000	735 000	782 000	670 000	16 000	.....	1 653 000	1 405 000	248 000
1899.....	874 000	756 000	850 000	726 000	22 000	.....	1 746 000	1 482 000	264 000
1900.....	1 056 000	951 000	935 000	818 000	41 000	.....	2 032 000	1 709 000	263 000
1901.....	1 046 000	948 000	989 000	880 000	36 000	.....	2 071 000	1 826 000	245 000
1902.....	865 000	766 000	910 000	786 000	37 000	.....	1 812 000	1 552 000	260 000

TABLE 10.—RAILROAD AND CANAL FREIGHT BETWEEN OPPELN, IN Mr. Sympher. UPPER SILESIA, AND BERLIN, THE PROVINCE OF BRANDENBURG AND HANOVER.

Year.	SUMMARY.			CLASSIFICATION.					
	Rail-road. Tons.	Canal. Tons.	Total. Tons.	HARD COAL.			OTHER FREIGHT.		
				Rail-road. Tons.	Canal. Tons.	Total. Tons.	Rail-road. Tons.	Canal. Tons.	Total. Tons.
1883...	1 186 000	235 000	1 421 000	1 073 000	37 000	1 110 000	113 000	198 000	311 000
1890...	1 849 000	243 000	2 092 000	1 647 000	105 000	1 752 000	202 000	138 000	340 000
1891...	1 791 000	871 000	2 662 000	1 563 000	463 000	2 026 000	228 000	408 000	636 000
1892...	1 641 000	973 000	2 614 000	1 425 000	533 000	1 958 000	216 000	440 000	656 000
1893...	1 697 000	1 018 000	2 715 000	1 467 000	561 000	2 028 000	230 000	457 000	687 000
1894...	1 415 000	1 145 000	2 560 000	1 212 000	629 000	1 841 000	203 000	516 000	719 000
1895...	1 415 000	1 047 000	2 462 000	1 222 000	576 000	1 798 000	193 000	471 000	664 000
1896...	1 382 000	1 256 000	2 638 000	1 178 000	725 000	1 903 000	204 000	531 000	735 000
1897...	1 470 000	1 477 000	2 947 000	1 263 000	835 000	2 098 000	207 000	642 000	849 000
1898...	1 653 000	1 577 000	3 230 000	1 405 000	838 000	2 243 000	248 000	739 000	987 000
1899...	1 746 000	1 798 000	3 544 000	1 482 000	984 000	2 466 000	264 000	814 000	1 078 000
1900...	2 032 000	1 713 000	3 745 000	1 769 000	875 000	2 644 000	263 000	838 000	1 101 000
1901...	2 071 000	1 726 000	3 797 000	1 828 000	946 000	2 774 000	243 000	780 000	1 023 000
1902...	1 812 000	1 895 000	3 707 000	1 552 000	1 097 000	2 649 000	260 000	798 000	1 058 000

The possibilities of further increase are not at an end, but the history of this canal shows that a well-equipped modern canal, properly located, is able to draw to itself large quantities of freight in a place where a small unimportant canal had had a hard struggle to maintain itself and had given opponents of canalization an opportunity to question its right to existence and to state that, in this day of railroads, canals are superfluous. Success was gained in spite of the fact that we are not dealing with a river, the maintenance of which calls for no expense, but with a canal that calls for various expenditures. The result has been that at the present writing this canal is not only paying for its maintenance, but is also returning 2% on the capital invested in it.

It is a matter of special interest to determine in what measure the railroad traffic has been decreased. In 1890, the year before the Oder-Spree Canal was opened, this traffic reached a tonnage of 1 849 000 tons, including 1 647 000 tons of coal, which was, up to 1900, the greatest tonnage observed for the traffic between Oppeln and Berlin, Brandenburg, and the harbors on the Elbe. A very gradual decrease took place up to 1896, when the figures were 1 382 000 tons, of which the coal tonnage was 1 178 000. In 1901, the figures show that the total tonnage had increased to 2 071 000, of which 1 828 000 tons were coal. For 1902, the figures were 1 812 000 and 1 552 000 tons, respectively, showing a slight decrease. The loss amounted to 467 000 tons in 1896 and was about 25% of the traffic as it existed in 1890.

Mr. Sympher.

Considering Berlin alone, where the Rhine-Elbe Canal would have allowed almost all the freight to be diverted to the water route, we have a reduction from 1 092 000 tons, of which the coal tonnage was from 974 000 to 745 000 and 647 000 tons, respectively, in 1896; and then a gradual increase up to 1901, which shows a tonnage of 1 046 000 and 958 000, respectively. For 1902, in this case, as in the larger one, a decrease again takes place, the total freight tonnage being 865 000, of which 766 000 tons were coal.

The maximum decrease amounted to about 32%, and it took about five years for the railroads to get back to their former tonnage. As the figures for Berlin show such a close analogy to those for the larger district, for further comparison, it will be ample to consider only the traffic between Upper Silesia and Berlin. If we distinguish between coal and other freight, coal being the heaviest of the large consignments, we can readily prove that the railroad loss is due mainly to the diversion of the coal hauling. For all other freight, the loss between 1890 and 1895 amounted to only 9 000 tons, having dropped from 202 000 to 193 000 tons in that period. In 1902 this business had increased to 260 000 tons. For Berlin, the figures are as follows:

1890.....	118 000 tons.
1895.....	94 000 “
1902.....	99 000 “

The loss amounts to 24 000 tons. Taking the totals of railroad and canal tonnage, we find that the total traffic between Oppeln and Berlin, Brandenburg and Hanover increased from 1 421 000 tons in 1883 to 2 092 000 in 1890, and in 1902 had reached 3 707 000 tons. In other words, the yearly increase before the canal was finished was 96 000 tons, and after its completion, 135 000 tons.

That this increase is to be credited to the canal can be seen from the following tabulation of railroad traffic between Berlin and Brandenburg on the one side, and all other districts, except Oppeln, on the other:*

Year.	Berlin. Tons.	Province of Brandenburg. Tons.	Total. Tons.
1883	2 558 000	2 514 000	5 072 000
1890	4 318 000	4 277 000	8 595 000
1896	5 017 000	5 682 000	10 699 000
1899	5 931 000	7 130 000	13 061 000
1900	6 690 000	8 123 000	14 813 000
1901	6 697 000	8 358 000	15 055 000
1902	7 105 000	8 892 000	15 997 000

* Hamburg is not included here, as its total traffic is not at all affected by the small amount of traffic between it and Upper Silesia.

This shows an average yearly increase, from 1890 to 1902, of about 600 000 tons, while the average increase of the period from 1883 to 1890 was about 500 000 tons. Mr. Sympher.

The above figures show that the traffic development on the Oder-Spree Canal is analogous to what may be expected for the canal between the Rhine and Hanover. The following facts have been proven as regards the development of canal traffic.

1.—The canal traffic increased very slowly at first, but finally reached a respectable figure.

2.—The railroad traffic showed a gradual loss at first, but soon recovered, and the maximum loss was never greater than one-third of the traffic of the canal in its opening year.

3.—The freight lost to the railroad was mostly rough and bulky freight, mainly coal.

4.—The canal has had a tendency to increase the total amount of freight from the surrounding country, and thereby materially increased the prosperity of the same.

5.—The railroad loss is due not so much to any diversion of existing traffic as to a diversion of the natural increase due to the building of the canal. In case the canal had not been built, railroads would have had to be. This was not so much the case in the districts we have been dealing with as in others, and is the main reason why work on the canal from the Rhine to Hanover should be started as soon as possible.

Should these conclusions be acknowledged as correct, no reason exists for doubting that the canal from the Rhine to Hanover will have a traffic that will justify its existence on one hand and will not materially affect the income of the existing railroads.

LIONEL B. WELLS, M. INST. C. E., Manchester, England. (By Mr. Wells. letter.)—Mr. North's reference to Mulhall's estimate of the cost of transportation in different countries is well worthy of attention by men of affairs and philanthropists.

When law and order have been assured to a community, the importance of good, rapid and cheap means of communication for passengers and freight becomes paramount, and each year as the means of locomotion generally is improved, enabling products from a greater distance to be used with advantage and economy, the cheapening of the cost of carriage within its boundaries becomes of greater consequence to each civilised nation and also to humanity at large.

When supplies were drawn from a short distance the cost per ton per mile was relatively of less account; at the present time it looms large, making for prosperity and comfort if it is fostered, and for poverty and decay if it is neglected.

The United Kingdom is in the unenviable position of being at

Mr. Wells. the top of Mulhall's list, with an average cost for transportation of 2.80 cents per ton per mile.

How this can be lowered is a problem which ought to receive the attention of all who are concerned for the welfare of England. Two generations ago the condition was reversed. With the sea at a moderate distance even from the Midlands, a network of canals, not then out of date, and a railway system in advance of other nations, our products were carried at lower rates than those of other nations.

Mulhall puts the ordinary cost of land carriage for goods in Europe in 1850 as 16 cents per ton per mile. This compares with rates varying from 2.50 cents in Italy to 1.56 cents in Holland obtaining at the present time, the English rate being, as already stated, 2.80 cents.

This, on the face of it, is an intolerable position, and ought to be faced. How can the rate be appreciably lowered without making greater use of waterways? and to be of real utility, the waterways must be improved and brought up to date.

The net receipts of railways compared to the gross receipts are continually diminishing in spite of the high rates paid for carriage. In discussing this question, side issues are continually raised. It is said to be due to excessive local rates and other causes, all acting to the disadvantage of the railway shareholder who, although, in some instances, he is amply remunerated for his enterprise, on the average is certainly not too well rewarded.

Some 14 or 15 years ago, long and costly enquiries were held both by officials of the Board of Trade and Committees of Parliament to investigate the question of the charges made by railway and canal companies for transportation. Some relief was obtained by the trader, but, as shewn by Mulhall's figures, this is not sufficient to meet the case.

If we look to Europe for guidance we see at once that countries that have the best system of waterways pay the lowest rate for transportation, viz., Holland, 1.56 cents, and Belgium, 1.60 cents per ton per mile. Belgium may be taken as somewhat similar to the manufacturing districts, while Holland compares with the districts in the eastern part of England, where the land is level and agriculture is almost the only pursuit.

The canal system of these two countries has long been well developed, and, in spite of the introduction of railways, water communication has not been neglected. New canals are being made and the old ones enlarged.

There are signs of a revival of interest in canals in England. The matter is before the Chambers of Commerce and when the Associated Chambers of the United Kingdom meet in Manchester in the autumn of 1904, resolutions will be brought forward by the

Manchester, Liverpool, and Worcester Chambers pointing to the necessity for the Government taking over the canals and working them in the public interest; or, as an alternative, that the canals should be placed under a National public trust with a Government guarantee, supervision and control. The Liverpool resolution is: Mr. Wells.

"That in view of the urgent necessity of cheapening the cost of the internal transport of goods and of the immense benefit that is bound to follow from the modernisation and extension of our inland navigations, this Association, being of opinion that the best results can be obtained only through unity of management, strongly urges that all the inland navigations of the United Kingdom should be acquired by the State or by a suitably constituted National trust."

The interest in this question has extended to the House of Commons; several influential men of affairs and of good commercial reputation are engaged in furthering measures for the consideration of the subject with a view to action being taken.

The Manchester Ship Canal was opened for traffic on January 1st, 1894; the traffic on it to the end of 1903 has been as follows:

1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
925 659	1 358 875	1 826 237	2 065 815	2 595 585	2 778 108	3 060 516	2 942 393	3 418 059	3 846 895

The distance from Manchester to Liverpool is 35 miles, and there are four lines of railway between the cities. The London and North Western Railway owns two of these, yet it has never been suggested at any meeting of railway shareholders that the railway companies have suffered in their traffic owing to the competition of this canal.

Of the loss due to the competition of electric trams, we hear continually, and the sums estimated to be thus abstracted from the railway receipts are specifically mentioned. If it were possible to ground a complaint against the ship canal it would have been voiced by the railway interest.

The trade of Manchester and the surrounding district has received an enormous impetus since the canal was opened and it continues to expand. A new industrial quarter has sprung up in Trafford Park, on the canal side, where the Westinghouse Company and a score of other manufactories are installed, employing thousands of men.

The depth of water in the canal is about to be increased from 26 to 28 ft. The lock sills admit of this. A basin, 15 acres in extent with the most modern appliances for dealing with the cargoes of

Mr. Wells. large ships trading here, is being added to the 104 acres originally provided.

During these years, Liverpool has been busily occupied in extending its docks, with far greater rapidity than in former decades, and of necessity, for her customs tonnage in and out, which in 1893 amounted to 16 831 700 tons, was last year (1903) 23 901 000 tons. Whilst Manchester has attracted 3 847 000 tons dead weight, Liverpool has added over 7 000 000 tons to her customs tonnage.

Liverpool opposed the canal to the uttermost. At the time, our great financier, Mr. W. E. Gladstone, a native of Liverpool, told the citizens that they would not suffer damage from the ship canal to Manchester, but, on the contrary, that they would derive benefit, because a new inducement to cause trade to flow into Lancashire would be brought into existence, and, seeing that Liverpool could never lose its position of advantage at the portal of the district, it must gain from the additional impetus given to the prosperity of the country at its back. Time has shewn his prescience.

TABLE 11.

YEAR.	CANAL TRAFFIC, IN AND OUT.	RAILWAY TRAFFIC, <i>Petite Vitesse</i> IN AND OUT.
	Tons.	Tons.
1872.....	256 804	505 400
1882.....	302 264	991 500
1883.....	345 190	1 021 000
1884.....	585 834	1 040 200
1885.....	694 082	1 069 700
1886.....	813 321	1 071 900
1887.....	849 593	1 079 800
1888.....	948 650	1 207 100
1889.....	960 859	1 295 460
1890.....	866 939	1 465 400
1891.....	996 635	1 596 500
1892.....	1 041 697	1 434 900
1893.....	1 101 281	1 455 300
1894.....	1 110 824	1 427 100
1895.....	990 694	1 273 100
1896.....	1 003 683	1 397 900
1897.....	1 079 606	1 429 800
1898.....	1 220 135	1 719 600
1899.....	1 077 561	1 674 900
1900.....	1 047 093	1 771 775
1901.....	1 106 727	1 743 950

The advent of the ship canal was contemporaneous with the removal of the Mersey Bar, on which dredging commenced in 1890. The bar has been removed and the channel of approach deepened to 25 ft. at dead low water. It is hard to suppose that the great traffic now passing in and out of Liverpool could have found accommodation under the old restricted conditions, as to time and depth of water.

That a large canal traffic is not detrimental to railway traffic is evident by studying the lines of trade followed in France from Paris to Havre and from Paris to the northwest and Belgium. It is also palpable to all who have watched the steamers and barges and the railway trains on both banks which traverse the valley of the Rhine. Mr. Wells.

Facilities of communication, when duly provided, give an impetus to trade which acts and reacts to the benefit of the district. This is exemplified in Table 11, which shews the weight of goods carried to and from Dunkirk by railway and canal in 1872 and 1882 to 1901 inclusive.

As money makes money, facilities beget trade, and the best available means of communication is a great promoter of trade and well-being.

TH. HOECH,* Esq., Kolberg, Germany. (By letter.)—In reading the paper, it occurred to the writer that the rates per ton-mile, reduced to cents, as given on pages 477 and 487, namely, Mr. Hoech.

England	Germany	New England	United States
2.80	1.64	1.16	0.80

recognized the rule that the unit of cost decreases as the length of the mileage increases. It follows that the larger areas have cheaper unit rates, partially making good the large average haulage to the points of destination. Still, there is another rule which applies, namely, that the density of population causes the number of short hauls to increase, and, similarly, the average freight rate, according to the first rule.

As to the cost of construction, the New England States were obliged to invest more money in railroad stations, in rights of way, etc., than the average State in the United States. Even the cost of the railway lines in New England is much greater than in the Mississippi Valley, and even in the Far West, with the long cañons which Nature has prepared for railroad routes.

Whether less capital invested in railways is lost in New England than the average in the United States, the writer does not know. Statistics cannot be considered perfect unless the rate of interest of the invested capital is given, and the loss of investments by foreclosures is counted in. One might perhaps find this rule to hold good, namely, that the more foreclosures the cheaper the rates. The writer would like to see it demonstrated that the rules of Nature prevail over human manipulations.

EDWARD P. NORTH, M. AM. SOC. C. E., New York City. (By letter.)—The valuable discussion contributed by Mr. Sympher shows how little, in Germany as in the United States, railroads have to Mr. North.

* Baurat.

Mr. North. apprehend from the competition of improved waterways. This practically endorses the theory of the German engineers under whose advice to their Government about \$150 000 000 have been expended during the past 20 years in improving German waterways, although the Government owns about 90% of the railroads of the country. O. Eltzbacher* sums up the results of this concurrent improvement of German railroads and waterways as follows:

	TONS CARRIED PER KILOMETER.	
	1875.	1895.
On waterways.....	290 000	750 000
On railroads.....	410 000	590 000

This great increase in tonnage per kilometer on the waterways must have been influential in reducing "the economically unproductive cost of transport" to the people of Germany. During substantially the same period, from 1882 to 1902, the boats engaged in internal navigation carrying 150 tons, or less, have decreased by nearly 20%, while those carrying 300 tons, or more, have increased by 565 per cent.

Since the Rhine has been deepened, many light-draft steamers find it profitable to escape the cost of transferring cargo at the mouths of the Rhine by running direct from British and North European ports to Cologne, while the transference of freight from deep-sea steamers at the Dutch ports is adding to the wealth of Holland.

Note should be taken, in considering the usefulness of 400-ton boats on the German canals, that the freight rates in Germany are about twice as high as in the United States.

The discussion by Mr. Hoech is very valuable in the suggestions made. But attention should be called to an apparent lack of discrimination between capital invested and the face value of certificates of indebtedness issued. The more doubtful the success of a projected railroad, the greater the excess of bonds over stock, which the law required to be full paid. This law did not apply to bonds and there were instances in the 20 years succeeding 1865 when for every dollar of stock two dollars in bonds of different denominations were issued. In such cases it is improbable, if, after bankers' commissions were paid, more than 25% of the face value of the so-called securities ever reached the office of the railroad company. But these practices were almost

* *Contemporary Review*, December, 1904.

unknown in either Groups I or II of Table 4, which present both Mr. North. the highest and the lowest average freight rates. Their exhibition was confined almost entirely to groups west of the Mississippi. Both seller and buyer knew this was blind and desperate gambling, and foreclosures were almost inevitable, but it is doubtful if, in the majority of such cases, values were wiped out, or the capital invested was sensibly impaired by the foreclosure. No statistician can perfect the rate of interest paid on the money actually invested in constructing our railroads. It would be extremely difficult for any road of great extent.

Nearly all railroads make rates that are, in some measure, inverse to the length of haul, and the traffic rules laid down by Mr. Hoech, if not intuitively suggested, will be immediately accepted as correct by all thinkers on this subject, but the rules are general and not rigorous in their application. Taking the second one:

"The density of population causes the number of short hauls to increase, and similarly the average freight rate."

The first year that "Poor's Manual" was able to collect statistics for all railroads in the United States was 1882; then our population was 16.89 per sq. mile; we shipped 6.87 tons per capita, which was carried 109.02 miles at a cost of 1.236 cents per ton-mile. In 1900, we had 25.2 people per sq. mile, sent 14.08 tons per capita 131.8 miles to its destination at an average cost of 0.746 cent per ton-mile. There are also other instances limiting this rule, *e. g.*, Belgium has 590, Holland, 400, and Germany, 270 inhabitants per sq. mile; yet, as given by Mulhall, the freight rates are, Germany, 1.64; Belgium, 1.60, and Holland, 1.56 cents per ton-mile, with probably shorter hauls in Holland and Belgium than in Germany. In view of the exceptions noted, it may be safely said that the rule defines a tendency and should not be accepted for any case without investigation.

The first rule: that the unit of cost decreases as the length of mileage increases, has few, if any, exceptions, but it does not seem applicable, as cited in a comparison between the rates in New England, 1.16 and 0.8 for the United States. Table 4, page 487, has no mention of the average ton-mile rate in the United States. It was not submitted as conclusive, but to show the effect of respectable and highly appreciated railroad commissions in upholding freight rates and driving heavy manufacturing out of the territory in which railroad building is controlled by them. Table 12, in which the groups are arranged as in Table 4, except that the miles of railroad are miles operated, as returned in "Poor's Manual," shows that Group I, though, with one exception, having the largest population per square mile, had the highest freight rate of all the groups. It also had the shortest haul of any group. But Group II, which is the most densely populated of all the groups and has the shortest

Mr. North. average haul of any but Group I, has the lowest freight rate, 52.6% of Group I, and to understand this question the rate of the Middle States, 0.61, should be interpolated between "New England" and "United States."

It probably will not be contended that the quantities moved, or constructed, in building railroads in the States of New York, New Jersey, Pennsylvania, Delaware, Maryland and the District of Columbia have averaged less than in the New England States, or that the right of way has been materially cheaper. But in these two groups the cost of construction has been much greater than in the other groups. The rate in Groups I and II is 0.66 cent per ton-mile where there is a population of 124 per sq. mile and the average haul is 103 miles, but in Groups III to VIII inclusive, where the population is 18.8 per sq. mile and the average haul is 155 miles, the ton-mile rate is 0.79 cent. Groups I and II, however, carry nearly three times the tonnage of the other groups.

As for capitalization, stock and bonds, "Poor's Manual" gives it as \$140 600 for Groups I and II and \$49 700 for the other groups. The value of this comparison is greatly impaired by the "water" in the stocks of some of the heaviest carriers in Groups I and II, and, by the fact, or possibly theory, that the water has been pretty effectually squeezed out of the capital account of roads in Groups III to VIII. There is, however, nothing to show that either a short haul or density of population increases the average freight rate. Nor is it apparent, as our railroad reformers declare, that a large capital account forces, *per se*, high freight rates.

Cæsus was truthfully told that some one with better steel would take his wealth. But better transportation has for centuries moved the wealth and power of the world. It supplies that commercial confidence which commands land, labor and capital in the service of production. When Brindley, with his coadjutors and followers, commenced canal building in England, they provided that country with the cheapest transportation in the world and developed that commercial confidence which carried England, with the further aid of its railways, to the front as a world power. But very shortly, what Sir Michael Hicks-Beach frankly admitted is a very powerful interest, the railway interest, bought canals so as to break up through routes and has succeeded in keeping England's methods of internal transportation and rates for freight without substantial improvement. At present, according to Sir Michael, at a late meeting of the Society of Arts, that interest will prevent any enlargement of English canals. It was between 1870 and 1880 that our average freight rates dropped below the English rates, and since that time, in any comparison of industrial and consuming capacity, England has seemed anchored.

TABLE 12.

Mr. North.

	YEAR.					
	1880.	1885.	1890.	1895.	1900.	1903.
UNITED STATES.						
Miles of railroad....	93 269	122 110	157 976	179 154	191 455	204 668
Freight hauled.....	437 040 099	701 344 437	755 799 883	1 071 431 919	1 299 684 061	
Length of haul.....	112.46	112.91	115.96	131.80	131.79	
Rate per ton-mile....	1.04	0.93	0.839	0.746	0.781	
Population per square mile.....	16.89		20.80		25.20	
Population per mile of railroad.....	537.59		397.54		397.41	
GROUP I.						
Miles of railroad....		6 476	7 011	7 659	7 841	7 738
Freight hauled.....	30 186 233	41 294 970	42 183 240	54 337 873	54 250 898	
Length of haul.....	59.81	69.40	79.99	82.94	85.91	
Rate per ton-mile....	1.56	1.37	1.24	1.16	1.18	
Population per square mile.....	60.42		70.82		84.24	
Population per mile of railroad.....	670.99		670.48		713.05	
GROUP II.						
Miles of railroad operated.....		17 794	19 314	21 890	24 710	23 425
Freight hauled.....	189 619 916	302 540 992	337 037 563	443 573 134	527 374 019	
Length of haul.....	91.50	84.89	89.52	105.86	105.30	
Rate per ton-mile....	0.84	0.82	0.71	0.61	0.67	
Population per square mile.....	100.88		121.36		146.80	
Population per mile of railroad.....	774.39		732.22		692.27	
GROUP III.						
Miles of railroad operated.....		42 199	50 936	53 732	58 067	60 154
Freight hauled.....	132 124 264	204 659 671	215 734 762	320 631 700	398 044 799	
Length of haul.....	144.44	136.28	133.10	137.73	133.42	
Rate per ton-mile....	0.89	0.79	0.76	0.69	0.70	
Population per square mile.....	45.01		54.10		64.30	
Population per mile of railroad.....	446.31		264.48		275.67	
GROUP IV.						
Miles of railroad operated.....		10 306	14 555	20 443	22,625	24 734
Freight hauled.....	15 888 029	35 185 795	45 800 646	65 547 112	80 168 159	
Length of haul.....	107.77	111.46	135.72	161.69	160.49	
Rate per ton-mile....	1.35	1.03	0.79	0.69	0.78	
Population per square mile.....	23.63		27.65		32.77	
Population per mile of railroad.....	747.93		569.56		388.60	

Mr North.

TABLE 12—(Continued).

GROUP V.

Miles of railroad operated.....	9 249	9 569	10 329	9 694	10 812
Freight hauled.....	19 197 613	36 780 161	26 779 193	40 391 899	50 268 899
Length of haul.....	102.43	98.38	137.37	141.35	145.58
Rate per ton-mile.....	1.43	1.04	0.89	0.83	0.83
Population per square mile.....	27.04	32.36		38.29	
Population per mile of railroad.....	932.82	788.73		921.12	

GROUP VI.

Miles of railroad operated.....	19 541	28 356	31 744	32 550	36 712
Freight hauled.....	27 690 116	38 272 891	43 655 714	63 615 069	93 844 012
Length of haul.....	132.32	176.26	166.88	197.01	179.37
Rate per ton-mile.....	1.74	1.35	1.24	1.00	1.00
Population per square mile.....	8.42	10.86		13.72	
Population per mile of railroad.....	416.94	291.92		321.44	

GROUP VII.

Miles of railroad operated.....	11 666	20 859	22 507	23 370	25 892
Freight hauled.....	16 835 340	31 623 004	52 918 571	61 411 037	77 831 015
Length of haul.....	159.15	201.33	199.77	182.27	201.95
Rate per ton-mile.....	1.46	1.06	1.04	0.95	0.91
Population per square mile.....	5.01	8.17		10.02	
Population per mile of railroad.....	247.25	238.60		261.28	

GROUP VIII.

Miles of railroad operated.....	5 835	7 376	10 849	12 576	12 109
Freight hauled.....	5 503 588	10 937 953	11 690 185	22 524 092	23 334 944
Length of haul.....	161.74	191.53	239.29	249.55	224.92
Rate per ton-mile.....	2.27	1.56	1.31	0.97	1.16
Population per square mile.....	1.94	3.17		4.26	
Population per mile of railroad.....	271.81	307.61		240.17	

The only noticeable improvement in England for over half a century that competes has been the Manchester Ship Canal. And Mr. Wells tells us that in 10 years the shipping entering the Mersey has increased by 56%, only about one-third of this increase going into the canal. It does not seem possible that the railways between Liverpool and Manchester, which joined in the fight against the canal, have had no increase of traffic through the business developed by this increase of tonnage.

Comparing the services per capita in 1882 and 1900, as mentioned above, it will be seen that the service of 1900 would have

cost us \$7.10 more per capita if the rate of 1882 had been charged. Mr. North. This is not only an addition of this amount to the net income of every man, woman and child, but it also gives a bounty of about 50 cents per ton on the consumption of our yearly products. And while our area is an important factor in our long hauls, the low cost of the service enters largely into both the length of haul and the quantity of our marketed products. It is doubtful if under the artificially high cost of transportation in Great Britain the adult males in that country could pay for a service of ~~1855~~ 1918 ton-miles.

Apparently no more economies in transportation in the service of the public are to be made by our railroad companies. For over 20 years a propaganda has been preached for restrictions to railroad building. The chief advocates are those who at one and the same time demand cheapness and denounce "ruinous competition." They have been successful in convincing the greater part of the voters in the City of New York that a canal bringing 8 000 000 tons to their wharves will be of more service than one bringing 20 000 000 tons. And they are hoping to prevent inconvenient competition by curtailing or abolishing those appropriations for the improvement of our water courses that have in the past paid profits on expenditure unapproached by other large investments, either National or private. Our legislators, executives and publicists are proposing plans for control which do not even suggest a reduction in the cost of transportation. None of them have the courage to advocate a return to our one time free railroad building, which would allow the cost of freightage to be governed by the best management rather than by the desires of stockholders.

The nation that will take our wealth from us by cheaper transportation is not yet apparent, but its unexpectedness may be partly gauged by reference to an assertion made by the late A. S. Hewitt, in 1870, when our freight rate was possibly the highest in the world, that England would probably continue to make more than half the pig iron of the world.

3 0112 062003642